THE CONTROL OF MEASLES.

A Thesis presented by

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THE CONTROL OF MEASLES.

This problem is one of the most serious and baffling that confronts the Public Health authorities. When it is considered that measles kills more children than all the other exanthemata (except whooping cough) put together, that it is the chief cause, in England, of loss of school attendance, and that it shows very little tendency to diminish, the importance of the subject is evident.

It is the purpose of this paper to show why measles maintains its hold on the community and to discuss the various means suggested for controlling it. Personal investigations have been made at very many of the London schools affected by the epidemic of this winter and Dr Kerr, Medical Officer (Education) to the London County Council has placed the school returns and schedules at my disposal.

History.

Our knowledge of the epidemiology of measles dates from a comparatively recent time, for the word was used vaguely, as a generic term for the leprous during the Middle Ages. The disease itself was regarded as a mild form of small pox, where the spots had "turned inwards" instead of maturating, until the

reign of Charles I. The first record of measles deaths appears in the London Bills of Mortality in 1629 but the disease was first described by Sydenham in 1670. As a vivid and accurate clinical picture of measles and its complications his account could not be surpassed to-day.

Measles continued to enjoy a mild prevalence during the eighteenth century, and in 1871 a Dr Black of London observes that "few escape it in infancy or childhood" yet "one tenth fewer die of measles than smallpox." It is interesting to note that the scanty records of the time show quite clearly the biennial rise and fall that is such a well marked feature of the disease wherever it is found.

Measles appears to have been first introduced into Edinburgh in 1735 from England. After causing an explosive epidemic it settled down quietly as an unobtrusive but constant resident. Not until the close of the century, when the diminution of smallpox by vaccination gave scope for another disease of infancy, did measles assume a serious aspect in either England or Scotland.

In 1808 a very malignant epidemic swept over the country. In Scotland it attacked persons of all ages and was particularly virulent in Glasgow. In severity it seems to have resembled the famous Fiji outbreak of 1875, more than any subsequent

epidemic in this country. During the next ten years several recurrences took place and measles began to assume a fixed place high in the mortality returns and became established firmly among the child population. In 1837, the first year in which definite information as to the prevalence and distribution of disease in England was published, it had the highest death-rate of all the exanthemata. That distinction it has retained ever since, with the exception of a few years, when small pox or scarlatina have been more destructive.

That measles is not diminishing in incidence cannot be proved by statistics in the absence of compulsory notification. But it can be shown that the death-rate from this cause in England and Wales shows little appreciable decline.

England and Wales.

Mortality per 1000 of the whole population.

In the 4 years 1847-50 = ·403

,, ,, ,, 1871-80 = ·379

,, 7 ,, 1901-1908 = ·311

In Scotland it has actually risen slightly.

Year	Mortality per 1000
1855 – 60	·43
1861 – 70	·42
1871 – 80	·36
1881 – 90	·39
1891 – 1900	·47
1908	·52

London shows a slight but steady diminution.

Period	Mortality per 1000
1841 – 50	·62
1851 – 60	·53
1861 – 70	·58
1871 – 80	·51
1881 – 90	·64
1891 – 1900	·58
1901 – 1908	·42

Meanwhile other exanthemata, e.g., scarlet fever, enteric, diphtheria, have been greatly diminished, and some, e.g., typhus and smallpox have been practically abolished.

The reason why measles does not follow suit is that its mode of spreading is different from that of the other exanthemata mentioned. Unlike typhoid and typhus, it is not spread by imperfect sanitation; unlike scarlet fever and diphtheria, missed cases and carrier cases play no part (with very rare exceptions[1]) in its propagation. Therefore modern advances in sanitation and bacteriology have had little effect on the mass of the disease.

Measles, like whooping cough, spreads by personal contact with an infectious person. Therefore the more closely children are herded together, the greater the number of children a sufferer will infect, and the more extensive will be the spread of the epidemic. The ever-increasing tendency of the population to

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[1]Dr Thomas has traced outbreaks on three occasions to children who had coryza but no rash. All were second attacks. See London County Council Report, 1906.

concentrate in towns has been quite enough to counter-balance the improvements in sanitation, bacteriology, etc., for a town child is a priori likely to come into contact with many more children than a country child, and it cannot be isolated so effectively when infection is in the neighbourhood.

That this explanation accounts for increased mortality, as well as for increased incidence, is shown by the following extract from a Report on measles to the English Local Government Board, 1909.

"In towns with a large working class population measles is always present and tends to recur in an epidemic every two or three years, whereas in country villages a period of twenty or even thirty years may sometimes pass between one epidemic and another. Hence in a country village large numbers of children pass through the susceptible ages (i.e. the ages when attack is most likely to be fatal) without exposure to infection."

The following tables demonstrate that measles is mainly a disease of urban life, and, more especially, of crowded urban districts.

England, 1909.

District	Death Rate per 1000 living
England and Wales	·35
76 Great Towns	·48
143 Small Towns	·33
Rest of England & Wales	·21

Glasgow, 1908.

No. of Rooms.	Cases	Deaths	Case Mortality.
1	3849	355	9·2%
2	14490	663	4·6%
3	2573	64	2·5%
4 +	855	13	1·5%
Institutions.	266	28	10·5%

Aberdeen 1893 — 1902.

No. of Rooms.	Cases	Deaths	Case Mortality.
1	1027	73	6·8
2	11464	348	3·0
3	6779	122	1·8
4	2046	19	·9
5+	2675	22	·8

London, 1909.

Proportion of Overcrowding.	Death Rate at 0·5 years per 1000 living.
Under 7·5	2·14
7·5 — 12·5	3·34
12·5 — 20	4·02
20 — 27·5	4·29
27·5 +	4·74

The amount of damage done by measles at the present day can be estimated in —

1. loss of life,
2. sequelæ,
3. educational loss.

1. Loss of Life.

In 1908 (the latest year for which the Scottish figures are obtainable) measles was responsible for the following deaths —

	Deaths at all ages.	Death Rate per 1,000.
England & Wales (1909)	8011	·353
Scotland	2503	·52
Edinburgh	78	·23
London (1909)	1524	·31

Its relative importance as a cause of death is shown in Table C. which gives the proportion of deaths from measles to every 10,000 deaths in the eight principal Scottish towns. Table D. indicates the very varying extent to which measles is prevalent in these towns, as shown by the death rates. For some reason it is much more fatal in the towns on the West coast than on the East, probably the secret lies in the greater dampness of the West.

2. Sequelæ.

Measles is not only a fatal disease but one particularly damaging to survivors. The extensive catarrhal inflammation set up by the measles organism is of itself of no grave import but it renders the patient intensely susceptible to invasion by other organisms, e.g. the pneumococcus, tubercle bacillus, and the commoner septic organisms. Dr Alexander

Lorey, in a recent investigation described in the "Zeitschrift fur Hygiene und Infectionskrankheiten" (Vol.63,Part I), found that erysipelas streptococci are the commonest cause of complications.

The exact amount of blepharitis, otorrhoea, damage to corneae, tuberculous lungs etc. due to neglected measles cannot be estimated by statistics, but it is probably very large. For example — 4·17 of the cases admitted to Colinton Hospital in 1908 had otorrhoea. I found in 1910 that out of 150 children attending the Nottingham Children's Hospital with discharging ears in 39 cases the discharge followed an attack of measles. An analysis made in 1909 of the causes of 500 cases of deafness in London County Council Deaf Schools gave the following results:

Measles	—	41 cases
Scarlatina	—	22 ,,
Diphtheria	—	6 ,,
Rötheln	—	2 ,,

3. Educational Loss.

Measles in schools is almost entirely confined to Infant Departments, so the interference with education it involves is not a very serious matter to the children. To the authorities it is everywhere a source of great annoyance and expense even when the exclusions are managed on the most economical system. Even in Edinburgh, where measles takes a place of

minor importance relative to other exanthemata, it was responsible for 702 absences in 1908. In England, where there is no "epidemic grant" and every excluded child represents a loss to the local authorities of 10d. per week, the loss must amount to many thousands of pounds a year.

Having thus reviewed the magnitude of the problem and discussed the conditions most favourable to the spread of the disease, we can turn to the possible means of amelioration. These can be best dealt with under four headings.

I. Compulsory Notification.

II. Exclusion from School of Children under 5.

III. Control in School.

IV. Improved Home Conditions.

I. Compulsory Notification.

This measure can be discussed on practical and theoretical grounds. Although it finds many advocates whenever an epidemic breaks out, we find that whenever tried, it has been abandoned as a costly failure.

In Edinburgh, measles was compulsorily notifiable from 1880 to 1890. It was then abandoned on the advice of the Medical Officer of Health as £3,500 had been spent on notification fees without benefiting the death rate or the incidence of the disease.

1901

Leith tried the same experiment later, with the same result.

Burton-on-Trent introduced notification from January 1894 to June 1900. On comparing the measles death rate in the six years preceding notification (1888-1893) with the notification period (1894-1900), an increase was found. In the latter period the

birth rate had diminished, so the number of susceptible children was actually less.

Aberdeen provides the most thorough demonstration of the futility of notification in dealing with measles. From 1881 to 1903 this regulation was in force and was rigidly carried out. Yet in 1903 the Medical Officer of Health, Dr Matthew Hay, felt obliged to advise the Town Council to drop the measure as practically useless and very expensive. There had been a considerable increase in the incidence rate and a slight decrease in the death rate. The case mortality, however, showed a marked reduction.

Aberdeen — Changes in Death Rate etc.

	1883 — 1892		1893 to 1902.	
Cases	16,120		24,254	
Death Rate per 100-000 pop.	62·4		43·0	
Case Mortality	1883–1887	1888–1892	1893–1897	1898–1902.
	5·3%	3·8%	3·5%	1·9%

In his analysis of the statistics collection during twenty years of notification, Dr Wilson, Assistant Medical Officer of Health, remarks:[1]

"The general decline of case mortality may be in

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[1]Public Health, Volume XVIII. No.2.

part due to the greater precautions and care exercised by parents in regard to cases on account of supervision by the sanitary department consequent on notification and to the printed instructions provided by the Department in each case. But too much must not be claimed for this."

In support of this view it must be pointed out (1) that the death rate was actually less in the fifteen years preceding notification than during the period:

(2) that the decline experienced in the last ten years of the notification period has continued since it was abandoned.

Aberdeen — Death Rate.

1856—1872	1873—1887	1888—1900	1908.
6·1	4·4	5·1	3·6

The explanation of the failure of these experiments in notification is found in the peculiar etiology of measles. Obviously, notification <u>per se</u> is only useful for the collection of statistics as a means of tracing the natural history of the disease; its practical sanitary value depends entirely on the extent to which it is followed by (1) Isolation, (2) Disinfection. In the case of measles both these measures are comparatively ineffective and impracti—

cable.

(1) Isolation is of little effect for checking the spread of the disease, because the patient is acutely infectious for three days before the appearance of a rash establishes the diagnosis. By the time the Health Authorities learn of the case, it has done all the damage by infection which it is likely to do.

Even if it were useful, it is difficult to see how isolation could be accomplished, for measles is most prevalent in quarters where isolation is most difficult: e.g., in Aberdeen in 20 years 19,310 cases out of 24,031 occurred in houses with three, two or one rooms. In Glasgow, during the 1908 epidemic, 20,912 cases out of 21,767 occurred in similar houses. Obviously these children could not be isolated at home, and the provision of hospital accommodation for such an enormous number of cases would put an intolerable strain on the rates.

(2) Disinfection is of very little value in view of the fact that contagion is almost entirely spread by direct personal contact. Fomites appear to play but small part in the spread of the disease. The weight of authority goes to prove that the organism cannot be retained long in clothes, furniture etc. but is transmitted directly from person to person.

So far as schools are concerned, disinfection may be positively harmful in that it diverts public

money which could be much better spent on securing a higher standard of ordinary cleanliness. The Reports of School Medical Officers for 1909 record many instances of school disinfection after measles. As they also record instances of schools which are scrubbed four times or even only twice a year it is easy to suggest a better use for the money spent on disinfectants.

The only advantage to be gained by making measles a notifiable disease would be the increased opportunities it would afford for educating parents and drawing their attention to the gravity of the complaint. It will be pointed out later (p.37) that this could be done through other channels just as effectively and without the expense of notification fees.

II. The Exclusion from School of Children under 5.[1]

This aspect of the problem peculiarly affects England, where school attendance is compulsory at five, and, in most districts is optional at three. In London 9,941 children under four and 34,468 under five were attending the County Council Schools in 1909. The exclusion from school of these children is urged on the grounds:—

(1) that about 80% of children attacked with measles are under 5:

(2) that 93% of measles deaths occur in this age period.

(3) that the aggregation of large numbers of children of the susceptible age in school-rooms is the main factor in spreading the disease.

The social and economic reasons that are the main factor in determining the English school authorities to open their schools to such young babies, are outside the scope of this thesis. But it must be pointed out that in towns the homes of the poor provide no space for the romping of an active child of three, nor can the mother spare time for supervision. For the slum-dwellers who crowd the "babies room", it is a choice between school and the gutter. (In practice it is found that country people and the better working class in towns do not, as a rule, take advantage

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[1]Less than 30% of children under five in London attend school.

of the low school age).

The alternative method of disposing of these children is by the provision of crèches. This is an expensive method and presents many difficulties in the way of staffing and supervision. As a means of spreading infectious disease a crèche, even if small and well managed, is likely to be as troublesome as a schoolroom.

(1) The benefit obtainable by excluding children under 5 has been exaggerated. The age-incidence of the disease cannot be accurately determined in the absence of notification, but the death-rate indicates that the most dangerous period is 0 – 3 years, not 0 – 5.

England and Wales, 1908.

Under 1	1 – 2	2 – 3	3 – 4	4 – 5	Under 5
1.89	3.90	1.64	.95	.59	1.85

Thus, even if the children were preserved from infection by the measure suggested, it comes too late to save the great bulk of the children who die from measles.

(2) Neither the death-rate nor the distribution of deaths has altered materially since compulsory education was introduced in 1870. If school attend-

ance was an important factor in the spread of measles among young children, one would expect a sharp rise of death-rate amongst those under 5 in 1870–1880.

Only the figures for London are available as regards children under 5.

	Year	Per 1000 living	Per 1000 under 5.
London 1909	1841–50	·53	3·89
	61–70	·58	4·18
	71–80	·51	3·65
	81–90	·64	4·74
	91–1900	·58	4·82
	1907	·38	3·29
	1908	·31	2·71
	1909	·48	4·18

(3) In Scotland, where children under 5 have never been allowed into school, the death rate from measles is actually higher than in England and the proportion of deaths occurring from 0 to 5 is almost the same.

	1908	
	Scotland	England
Death-rate per 1000	·52	·22
Proportion of deaths occurring 0 – 5	92·89%	93%

Dr Chalmers of Glasgow in his Report to the Local Government Board on the epidemic of 1907 – 1908 collected the following statistics.

Age	Estimated Population	Cases	Deaths	Attack Rate	Case Mortality.
0 – 1	21,467	1575	256	7.3.	16·2
– 2	18,974	2690	509	14·2	18·9
– 3	19,136	3334	178	17·4	5·3
– 4	18,572	3091	76	16·6	2·4
– 5	17,850	2956	40	16·5	1·3
5 – 15	162,735	8026	56	4·9	·7

N.B. The number of children attacked under 5 is probably underestimated as information was received through the schools.

In Glasgow little more than half the children of 5 to 6 attend school.

Dr Chalmers adds "the epidemic attacks the earlier ages at more than three times the rate prevailing among children at the period which includes those who are attending school.

"The inquiry shows that the main volume of a measles outbreak in town at least is supplied from children who have not reached school age, a fact which of itself helps to explain why school closure in Glasgow in the past has failed so frequently to stem the tide of a measles epidemic."

Dr Newsholme, and other advocates of a higher school age, have shown that in many cases measles is introduced into a household by the three or four year old child who has contracted the disease in a babies' class. This cannot be denied, but the experience of Scotland goes to show that the same children would be

just as likely to acquire measles in a park or common stair.

Dr Beatty,M.O.H.[1] for Northampton, in discussing an epidemic of 1906, states, "Every death has been investigated and it is surprising to find how many young infants died who had no brothers or sisters attending school. In these cases the infection was generally traced to playing with others in the streets who afterwards developed measles."

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[1]Transactions of the Second International Congress of School Hygiene 1907.

III. The Control of Measles in School.

Before any effective regulations can be framed for dealing with measles in school, the way in which it spreads must be known. No exact information on the subject was forthcoming and regulations were framed in a hap-hazard manner, until Dr Thomas, Assistant Medical Officer to the London County Council carried out his "Woolwich Experiment." He had two objects in view, firstly, the elucidation of the school epidemiology of measles, secondly the discovery of the value of class closure.

The experiment and its results are so well known that they need only be briefly recapitulated here. All cases of measles occurring among school children in Woolwich between 1903 and 1906, inclusive, were recorded on charts, and home investigations made in many instances to clear up their origin. The measles history of each child in the schools was ascertained for the first time. By an arrangement with the Medical Officer of Health the Borough was divided into two nearly equal parts. In the East district, a class was closed directly a case of measles was notified in the West district, exclusion of susceptible children only was practised.

After four years of this experiment Dr Thomas came to the following conclusions, which were embodied in a Report to the London County Council in 1906.

(1) Probably every human being is susceptible to measles unless protected by a previous attack.

(2) Second attacks are rare.

(3) It is impossible in towns to prevent the frequent introduction of measles in schools.

(4) Measles spreads in classes in crops: The first crop occurs about 12 days (the limits appear to be 9 to 15 days) after the introduction of the first case and comprising a few children, the second crop falls about twelve days later and includes the bulk of the unprotected children. The fourth crop is always inconsiderable and sometimes nil.

(5) Measles tends to spread wherever a class accumulates unprotected members to the extent of 30% to 40%. When spreading has begun it continues till the proportion is reduced to between 15% and 20% unprotected.

(6) When 75% of the class are protected measles does not tend to spread, even if no action to check it is taken.

(7) Measles is not carried by healthy persons and children who have had the disease can be allowed to attend the upper school with impunity.

CHART I

TIMBERCROFT ROAD. WOOLWICH

CLASS	AGE	PROTECTED	UNPROTECTED	NOVEMBER 1905 15 20 25 30	DECEMBER 1 5 10 15 20 25 30	PROTECTED	UNPROTECTED
I	5-6	46	31	■	1ST CROP. CLASS CLOSED; 2ND CROP. ■ ■	74	3
II	3-4	35	34	■ MISSED CASE	1ST CROP; CLASS CLOSED 2ND CROP	64	5

DEANSFIELD ROAD WOOLWICH.

CLASS	AGE	PROTECTED	UNPROTECTED	JANUARY 1906 15 20 25 30	FEBRUARY 1 5 10 15 20 25 28	PROTECTED	UNPROTECTED
A	3-4	12	10		1ST CROP; CLASS CLOSED; 2ND CROP ■	20	2
B	4-5	10	11		1ST CROP; CLASS CLOSED; 2ND CROP	20	1
C	5-7	28	8.	■	1ST CROP; CLASS CLOSED; 2ND CROP	36	0

□ = CLASS CLOSURE

□ = 1ST CROP

□ = 2ND CROP.

(8) As a rule secondary cases arising from a single case fall only in the same class. Exceptions are found in over-crowded and unhygienic schools. (See Chart I).

(9) Class closure has no greater effect in checking the spread of measles than has the exclusion of the unprotected children only.

At the end of the four years' experiment, Woolwich as a whole showed a decrease in the incidence of measles and in death-rate, yet the gain was actually less in the closing than in the non-closing district, other conditions being almost similar.

These conclusions have been embodied in a Memorandum of the English Local Government Board, and are used by most school authorities as the basis of their methods of dealing with measles. They have been confirmed by other workers, notably Dr Chalmers of Glasgow and Professor Eberstaller of Gratz, and warrant the following deductions.

A. The preliminary factors essential for the control of measles in school are:-

I. The measles history of each child must be ascertained on admission to school and be kept up to date by the teacher. The value of this step in enabling the authorities to judge whether a child is 'pro-

tected' or not, is shown by the fact that in the Woolwich experiment Dr Thomas found that only 7·6 of the children who suffered were reported to have had measles before. Error is likely to arise from three sources, viz:—

(1) Genuine second attacks. Authorities are unanimous that these are rare. In Aberdeen during the second ten years of notification they were 2·6% of the total cases notified between 0 and 15 years. Witowitz, who analysed several thousand cases, only found one example. The experience of Professor Eberstaller[1] of Gratz is worth detailing. Since 1889 he has kept a Register of Infectious Diseases at the Town Hall and can ascertain at once from which diseases any particular person has suffered and when. He records no instance of a child whose name is on his Measles Register subsequently developing the disease.

(2) Confusion with German Measles. Little is definitely known about the spread of this disease in school or among the general population. Information is difficult to obtain as parents do not seem to recognize it as a separate ailment. It is usually called "mild measles," or "spring" or "stomach rash." No opinion can therefore be advanced as to the extent to which this disease acts as a source of error.

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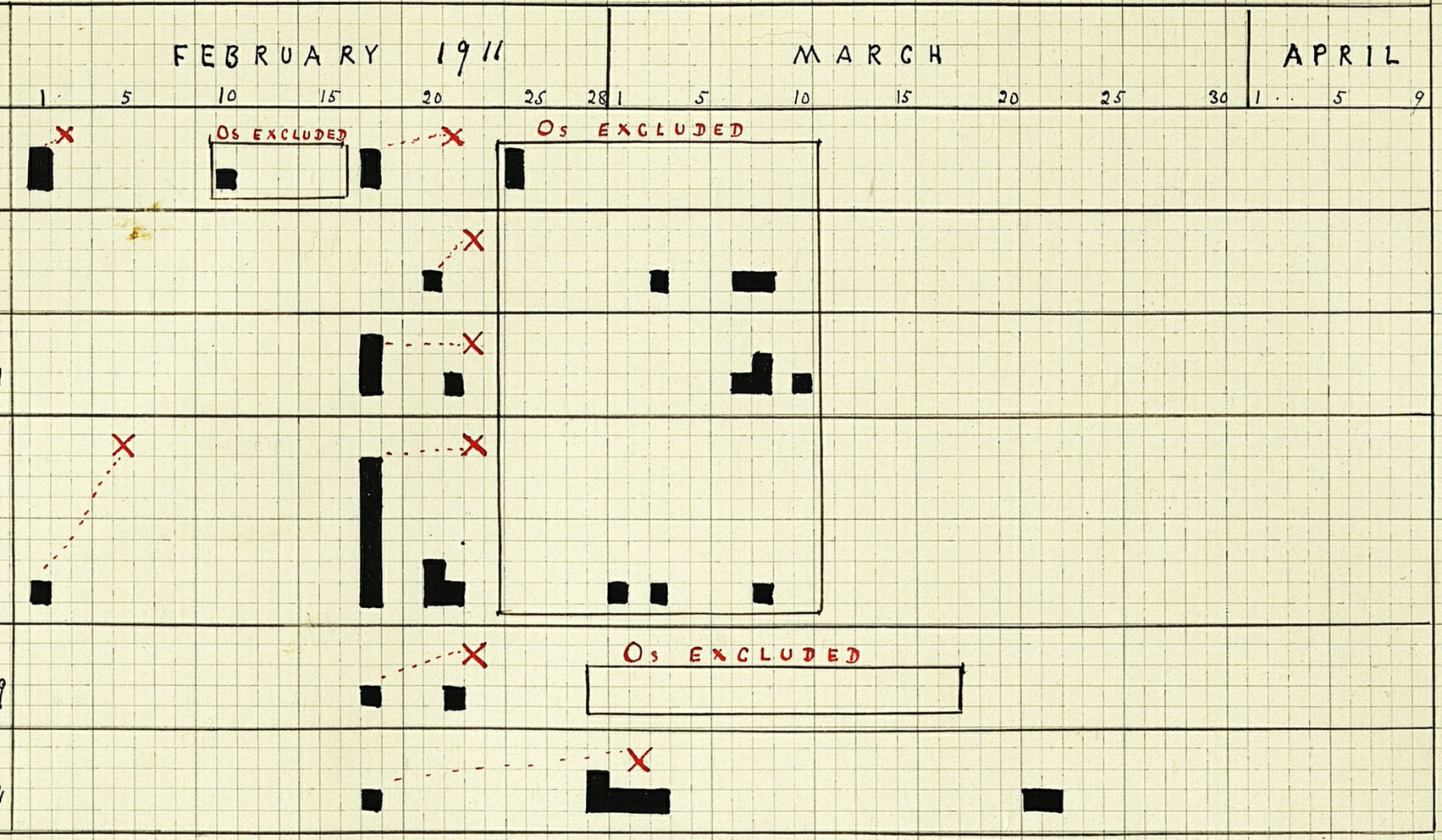
[1]Public Health, Vol.XIX, No.2.

CHART II

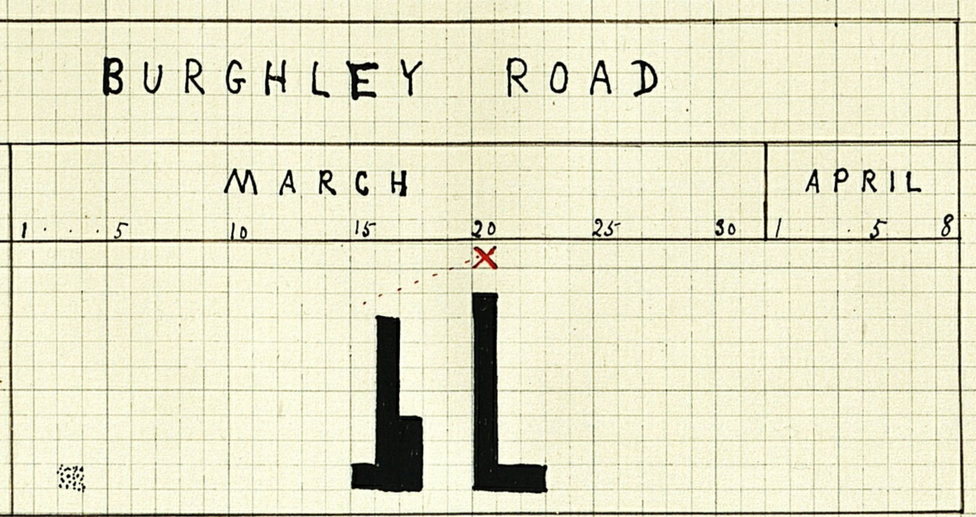
ADYS ROAD

CLASS	AGE	PROTECTED	UNPROTECTED
E	6	27	19
G	7	25	11
B	5	32	21
H	6	50	3
F	4	15	29
G	4	45	14



BURGHLEY ROAD

CLASS	AGE	PROTECTED	UNPROTECTED
A	7	45	4



▒ = POSSIBLE MISSED CASE

Several outbreaks in London schools have been investigated in the last few months.

Adys Road, E.Dulwich. See Chart II.

The cases from this school were at first reported, and dealt with, as ordinary measles, but on February 25th, the Headmistress of the Infants' Department wrote,

> "of the 17 cases reported on February 22, 9 are from Room H. and 8 of these are second attacks. . . the parents tell me that the children generally are well. We have carefully watched for preliminary signs of measles, but there have been none till the rash appeared. After thirty years' experience of measles in schools I am puzzled by the nature of the epidemic."

It was found on investigation at the school that the cases had presented all the symptoms of German Measles, though in several cases the children were sent back in a couple of days with a medical certificate stating that nothing was wrong.

The Headmistress, a woman of keen observation, had observed that when doubtful about the presence of a rash on a child's face she could always bring it out by putting the child close to a fire or radiator. This hint might prove useful where the prompt detection of infectious children is desired.

It is noteworthy that forty-three out of forty-five children attacked in this epidemic had had ordinary measles. The Class H, with only three "unprotected" cases suffered most; the Class F. with 66·6% "unprotected escaped with two cases.

A very unusual outbreak occurred at Burghley Road School. Twenty-one cases of "measles" were reported on March 20th and 23rd as occurring within eight days in a single classroom. All were so-called "second attacks." Fortunately the last case, occurring on March 22nd, was seen by a visiting doctor, so no doubt remained as to the nature of the outbreak. The rest of the school remained entirely free from infection. The registers were carefully examined for suspicious absences between February 28th and March 3rd. The only child who could possibly have given rise to the infection was a little girl who last attended, apparently in excellent health, on March 2nd, and was taken ill that evening with a sick headache, slight sore throat and cough, which kept her away for a week. Three other children in the family suffered simultaneously, but in no case was a rash noticed. Even if the rash was overlooked, it is difficult to see how one child could give rise to such an explosive outbreak in a healthy schoolroom. But the affected children never met out of school and no other origin of the trouble could be suggested.

In two other schools where large numbers of "second attacks" were reported investigation on the spot proved that many of the cases were undoubtedly rötheln. The presence of ordinary measles in the school at the same time interfered with the accuracy of my observations. However, the evidence from the cases observed in London schools warrants the conclusions

(a) that German Measles usually appears simultaneously in several classrooms.

(b) that it does not spread in school, to any serious extent. The successive "crops" are small, consisting usually of one, two or three cases; the high rate of geometrical progression shown by measles is not a feature of rötheln epidemics.

(c) the disease tends to die out of a school fairly quickly even where no action is taken.

(3) Forgetfulness, or deliberate misstatement on the part of the parents. The busy mother of a large family is often pardonably vague and confused about the medical history of her children, but teachers do not seem to consider this a serious source of error. Serious inaccuracy was only found in a few schools in squalid districts in East and South London. Here the parents appear to have learnt that children who have not had measles are thrown on their hands

from time to time, and to avoid this they falsely declare that the child has had the disease.

The general consensus of opinion among head-teachers who have every opportunity of judging, is that in the vast majority of cases the measles history is given in good faith and is reliable. No definite information is afforded by the London returns of the number of supposedly 'protected' children who fall in school, but the total number is not sufficiently great to interfere with measures for the school control of the disease.

II. Prompt notification to the School authorities is absolutely necessary if any effective measures are to be taken. In practice it is found that the gross carelessness of parents in this respect is one of the great stumbling blocks to efficient school control. Over 10% of the cases in London schools are first notified by the Attendance Officer, who does not start his enquiries till the child has been absent for a week. Numerous letters from head-teachers could be quoted, complaining bitterly of evasion and attempted suppression of information on the part of parents. The result is that in many cases information concerning the first case does not arrive till the first crop has fallen and the bulk of the susceptible children have already been infected. The outbreaks in Rosendale Road and Berkshire Road schools

(see Charts III. and IV.) are good examples, of the havoc too-late notification may work in a school.

To make notification within (say) forty-eight hours to the School Authorities compulsory on the parents would be a tremendous help to the School Medical Officer, but is considered to be hardly feasible by London workers. The difficulty is that the careless parent could always plead that he "didn't know it was measles," and the regulation would be difficult to enforce. I would like to see it tried, however, for the mere threat of a penalty has a wonderful effect in stimulating a slack "social conscience."

III. Intelligent co-operation is necessary on the part of teachers. If the spread of measles is to be checked a teacher must be prepared not only to recognise a rash, but to exclude children who present suspicious catarrhal symptoms. This means, of course, that the teacher must be willing to put the health of her class above her personal interests, for promotion depends to a certain extent on attendance records. Allowance should also be made for absences due to infectious disease in granting attendance medals in order that neither pupil nor teacher should be made to suffer for attention to hygiene.

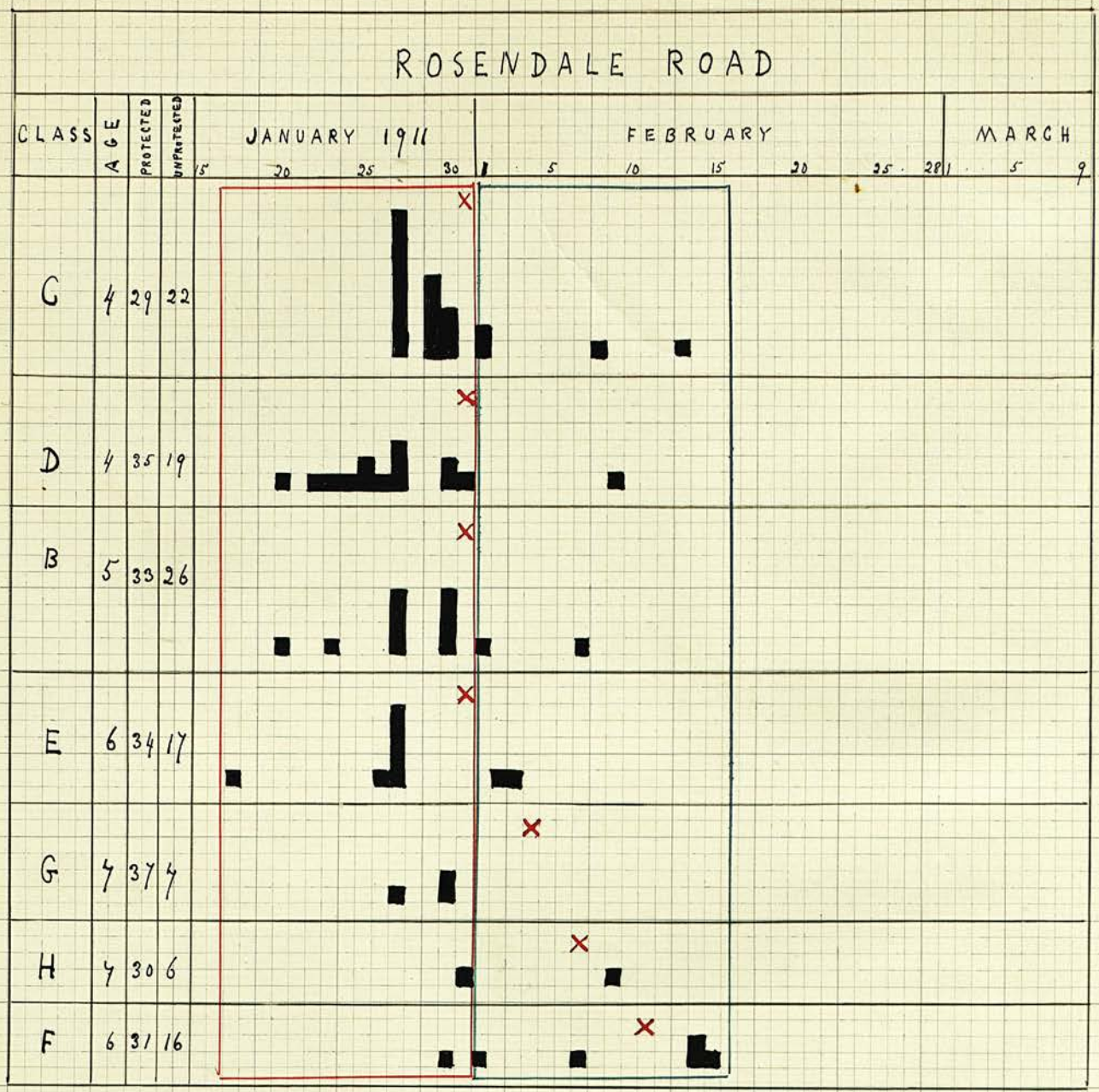
IV. Reasonably good hygienic conditions must prevail in the school. Where overcrowding and bad

ventilation are present the School presents the same serious problem,as the "slum", i.e. the infectious, child will come into contact with a larger number of children than she would in a properly arranged school, and the bad ventilation will lower vitality and make the children peculiarly susceptible to infection. In these conditions a single case may cause an "explosive" outbreak, and practically all the susceptible material will fall with the first crop.

The outbreaks studied by Dr Thomas at Timbercroft Road and Deansfield Road (see Chart I), two ill ventilated and crowded temporary buildings, demonstrate this point clearly without further analysis. Although class closure was promptly applied to the classes from which the initial cases were notified, 81·5 per cent of unprotected children were attacked in Timbercroft Road and 90 per cent in Deansfield Road. In the latter school one child infected eighteen children in three classes.

V. The children excluded during epidemics should be kept from meeting in other places. This is recognised to be a "counsel of perfection" where town children are concerned; but parents, even in slums, could do far more than they at present attempt in this matter. One head teacher wrote to the London Education Medical Officer a few weeks ago, "I have carried out your regulations concerning measles as strictly as

CHART III


ROSENDALE ROAD
CLASS
AGE
PROTECTED
UNPROTECTED
JANUARY 1911
FEBRUARY
MARCH
15 20 25 30 1 5 10 15 20 25 28 1 5 9
C 4 29 22
D 4 35 19
B 5 33 26
E 6 34 17
G 4 37 4
H 4 30 6
F 6 31 16
= DATE OF 1ST NOTIFICATION
= CASES FALLEN BEFORE 1ST NOTIFICATION
= CASES INFECTED BEFORE 1ST NOTIFICATION.

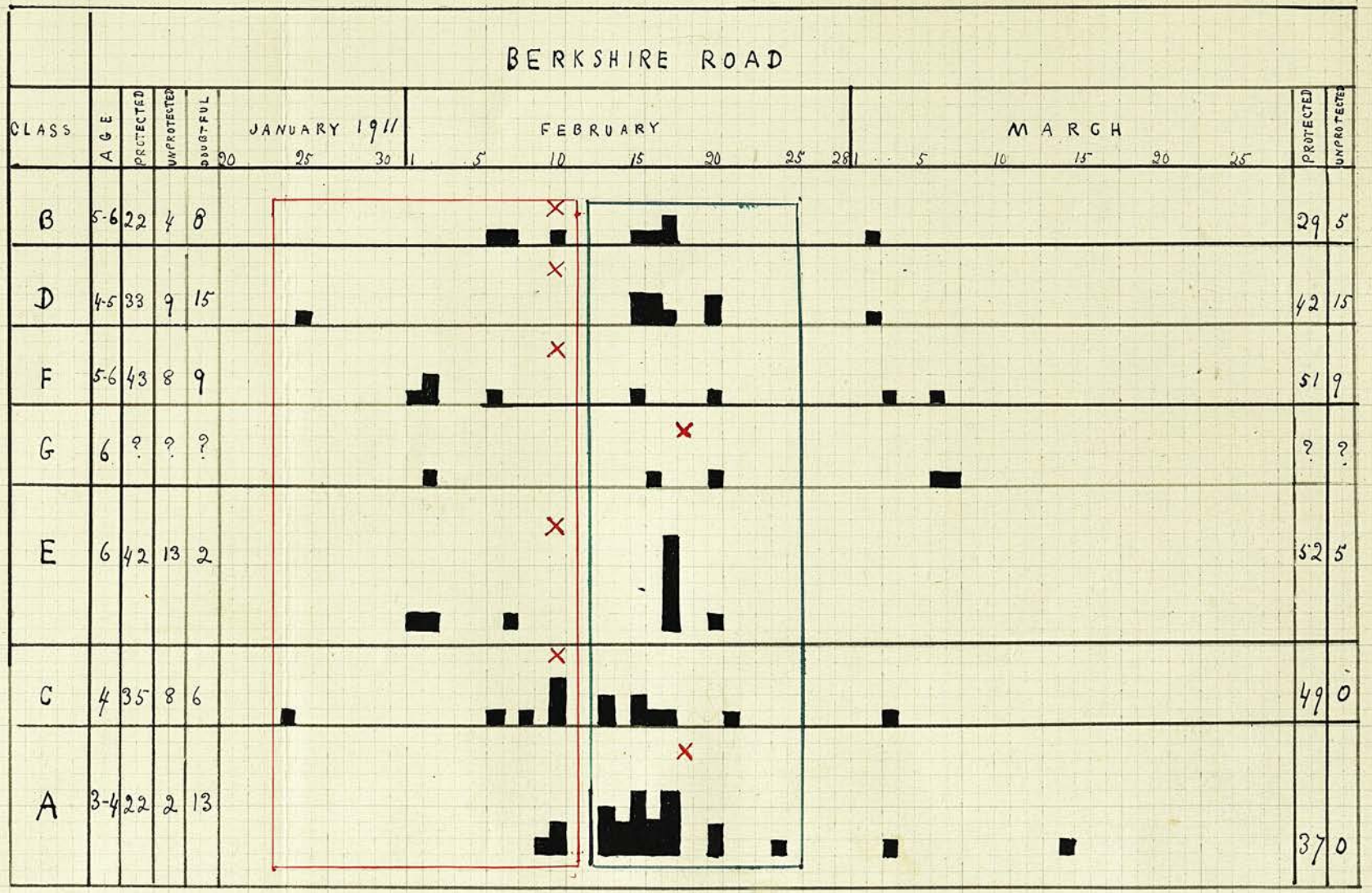
possible, but we get new cases every day, in different classes. I do not wonder as I can see excluded children and early convalescents playing together just outside the school gates. The parents will give us no help." The only remedy seems to lie in patient and energetic dissemination of knowledge through every available channel.

B. Any action to be effective must be taken within ten days of the occurrence of the first case, and before the first crop of secondary cases has had time to fall in school, otherwise the majority of the susceptible children have become infected, and no action, however vigorous, can be of real service in checking the spread of the disease.

This is well demonstrated by Charts III. and IV. representing outbreaks at Rosendale Road and Berkshire Road Schools during the present epidemic.

At Rosendale Road, the first cases, occurring early in January, were missed and not known for several weeks. The first intimation of the outbreak was given on January 31st, when 17 cases were notified from four classes. It was recognised that it was too late to avert disaster, and events proved that every child who fell had already been infected at the date

CHART IV



× = DATE OF FIRST NOTIFICATION

= CASES FALLEN BEFORE FIRST NOTIFICATION

= CASES INFECTED BEFORE FIRST NOTIFICATION

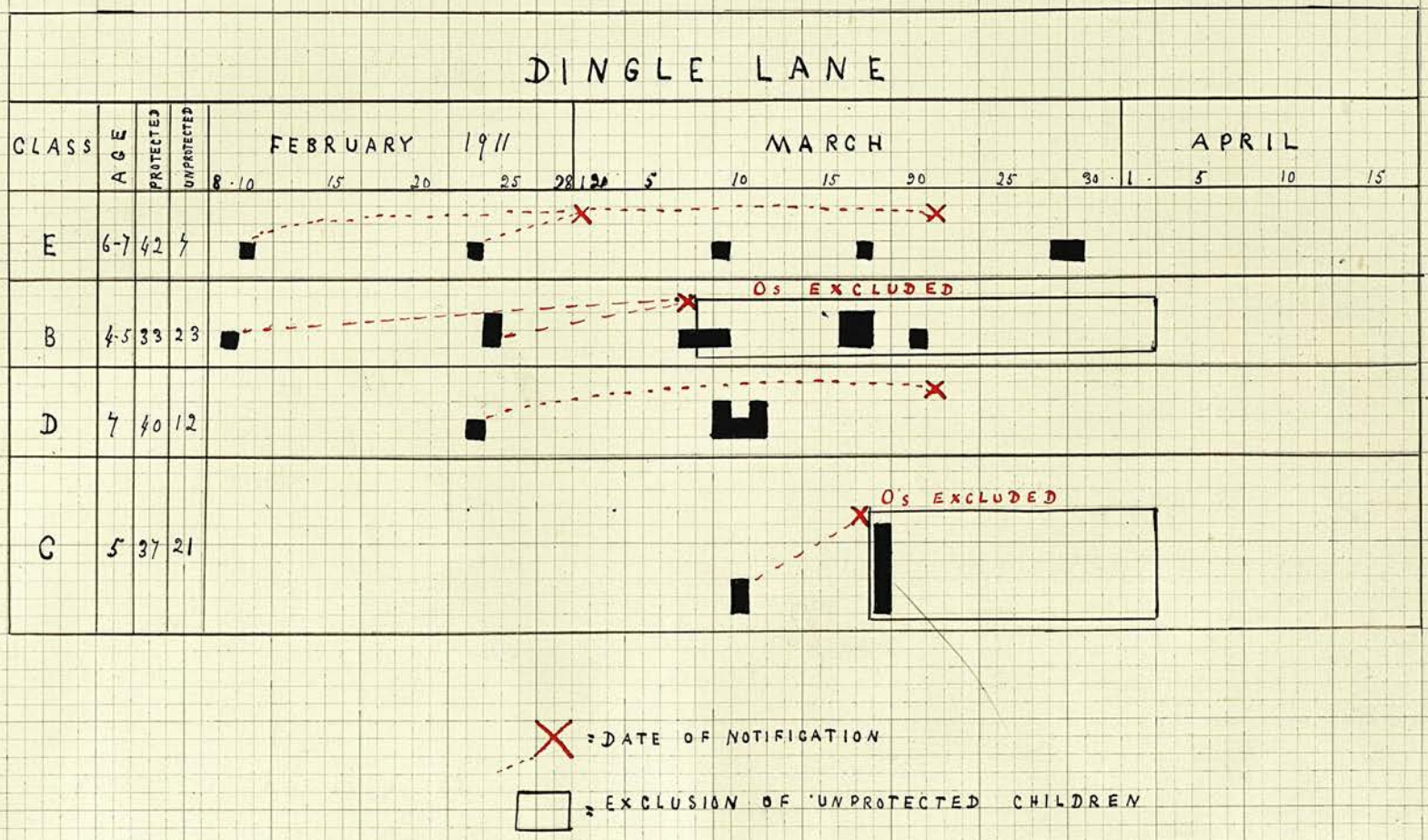
of the first notification. Here school closure would not have saved a single case, but it would have appeared to stop the outbreak.

At Berkshire Road two cases occurring on January 24th and 25th in Class Rooms D. and C. were missed and no warning was given till February 10th, when a first crop had begun to fall in five classrooms. Obviously the disease had got out of hand, and no action was taken. The chart shows that all the children who suffered subsequently, except nine, were infected by the time notification was first given. This chart also demonstrates that in an old-fashioned and ill-constructed school the disease spreads more widely and exhausts more material than in hygienic buildings. The futility of the course still adopted by some authorities of waiting till the percentage of attendances has fallen to a certain level before closing for measles, is so obvious that it does not merit discussion.

C. Exclusion of unprotected children during the period when the first crop is likely to fall (i.e., nine to fifteen days, inclusive, after the last attendance of the initial case) will prevent an outbreak quite as effectually as the closure of the whole class.

Exclusion has special advantages over closure, viz:

CHART V


DINGLE LANE
CLASS
AGE
PROTECTED
UNPROTECTED
FEBRUARY 1911
MARCH
APRIL
8 10 15 20 25 28 1 5 10 15 20 25 30 1 5 10 15
E 6-7 42 7
B 4-5 33 23
Os EXCLUDED
D 7 40 12
C 5 37 21
Os EXCLUDED
= DATE OF NOTIFICATION
= EXCLUSION OF UNPROTECTED CHILDREN

(1) there is less disturbance of education. Measles outbreaks must inevitably occur frequently in an infants' school, and it is a great gain if the children who have already passed through an attack should be allowed to continue their work in peace.

(2) the loss in grant to the local education authorities is less and in classes where many children are protected the difference will be quite worth considering. This is more important in England, where by some official freak, the "epidemic grant" has been withdrawn.

(3) the "sheep and the goats" are separated and even if a "protected" child's history has been inaccurate and it does fail in school, it can do little damage. The rest of the susceptible children are at home.

This point is demonstrated by Chart V, which depicts the outbreak in Dingle Lane School in 1911. In Class B, information was received on the 8th March of two cases which had last attended on the 24th. Exclusion of the unprotected children was ordered at once but came too late to prevent the first case of the first crop from falling in school on the 9th March. During the exclusion period five children who were supposed to have suffered before, but had evidently been infected by the case on 9th March, fell in school. However, all the other susceptible children

were at home, no secondary cases occurred, and the outbreak ceased.

Dingle Lane chart also demonstrates a successful result of the exclusion policy in Class C. which contained a high proportion of unprotected children. In Class D. no notification was received till the first crop had already fallen, so no action was taken. 70% per cent of the children were protected and the disease did not spread.

In only one case can class closure be preferred to exclusion, namely when the numbers of unprotected children is so large that the depleted class would not be worth teaching.

D. The closure of infants' schools during an epidemic is a measure strongly urged on school authorities whenever measles becomes rife in a town and the death-rate rises, and it is one frequently adopted. It is a serious question whether it has any real effect in checking the march of an epidemic.

It must be remembered that town children have innumerable opportunities of meeting together. Excluded from school they continue to assemble under less hygienic conditions in Sunday Schools, penny cinematograph shows, public playgrounds and neigh-

bours' back-yards. There is the further disadvantage that the skilled supervision of the teacher is withdrawn and a case is less likely to be detected in the infectious catarrhal stage. Also, schools form the only channel, in the absence of compulsory notification, whereby a Medical Officer of Health can obtain information about the incidence of the disease. The closure of the schools leaves him quite in the dark, except for the death-rate. Perhaps the most important consideration of all is that by shutting the schools parents can no longer be warned and instructed about the dangers of the disease through notices conveyed by the scholars.

In Glasgow, during the epidemic of 1907 to 1908, Dr Chalmers tried school closure with disappointing results. In the Report previously quoted he states "In the autumn months (of 1907) 60 out of 110 schools were invaded. At intervals 33 Infant Departments were closed for three weeks, but cases increased from 2,291 in November to 3,759 in December."

The New Year holidays were extended to three weeks from the 21st December, and at first a decrease at all ages followed the holiday period. The epidemic soon burst out worse than ever, and the cases in February and March were as numerous as in November and December. See Table B.

In the present London epidemic the closure for

the Christmas holidays from December 12th to January 13th had little appreciable effect on the incidence of the disease. (It must be remembered that many cases occurring during the holidays are never reported). The slight fall in the death-rate in the first weeks of 1911 is discounted by the fact that a new system of recording deaths was then started in London, the deaths of non-residents occurring in the city being, for the first time, excluded. See Table A.

In a paper[1] dealing with an epidemic in St. Helens in 1909, Dr Paterson, Assistant Medical Officer of Health for the Borough, records that school closure was successful when other methods had proved futile. He had already tried repeated class closure and the schools were almost daily inspected by himself or the school nurse for incipient cases. However, his statements show that when the schools were reopened on April 26th, after being closed for six weeks (including the Easter holidays), the attendance was so poor that they had to be shut for another fortnight! Now all the children absent with measles on April 26th, must have been infected during the holidays, so obviously the disease had continued to spread out of school.

It seems probable that success is attributed to

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[1] "Public Health" for October 1909.

school closure in epidemics owing to indulgence in the same fallacy that credits class closure with checking small outbreaks. In other words, that school closure has been enforced when the susceptible material in a town was already nearly exhausted and the epidemic had "burnt itself out." In London great pressure was brought to bear on the County Council to close the schools when the deaths from measles became so numerous in March. On the advice of their Medical Officer they refused; not only did he consider the measure useless for the reasons already detailed, but he considered that the susceptible material was becoming exhausted. Had the schools been shut the diminution in cases and deaths which began immediately after and is still proceeding, would inevitably have been attributed to the closure.

In country districts where children have fewer opportunities of meeting apart from school, the case is very different. Closure of a school-house may then have excellent effect in limiting the disease to a small area. In towns it does not appear of sufficiently definite value to warrant the very serious interference with education it entails.

IV. Improvements in Home Conditions.

The main incidence of measles then lies outside school age, and its spread, in an urban community, is ultimately independent of school influences. With an ignorant and overcrowded population measles is bound to spread and take its toll of infant life, whether the schools are closed or not. The true solution of the problem lies not in the school, but in the home; and improvement must take place in this direction if the ravages of measles are ever to be abated in our towns.

The primary object to be aimed at is improved education of the parents. An enormous amount remains to be done in eradicating the popular delusion that measles is a trivial complaint and requires no care or medical supervision. Child sufferers are recklessly exposed to cold, the discharges from eyes and nose are neglected, and early convalescents are allowed into the street to infect others.

If properly used, the existing means of disseminating knowledge among the people would probably be sufficient without introducing compulsory notification. For example, Health Visitors appointed under the Notification of Births Act could distribute advice and leaflets on the subject during their routine visits; the "Schools for Mothers" and the "Mothers and Babies Welcomes" should take the opportunity of advising

their patients in a similar way; Evening Class Lecturers on Hygiene, Infant Care and Home Nursing could deal briefly with the subject. Well-informed articles in the popular press would probably do more than anything else to warn parents of the danger of measles, and the precautions to be taken.

It must be recognised that in a poverty-stricken community the uses of education are limited. Obviously the knowledge and the will to treat a measles case properly are useless if the money is not available. Therefore, if the death-rate is to be reduced, adequate and free hospital accommodation should be provided for necessitous cases.

This point needs little labouring in Edinburgh where the beautiful wards at Colinton are accessible to all, but in England it finds very tardy recognition. London only decided to open wards in the hospitals of the Metropolitan Asylums Board early in March 1911, and even now only the worst cases could be admitted. In many large towns to this day there is no means of obtaining good nursing and healthy surroundings for the "slum" child suffering from complicated measles.

In conclusion, it must be recalled that measles is par excellence a disease of urban communities, and no very marked improvement can take place until the underlying cause — overcrowding — is vigorously

dealt with. The destruction of slums and the gradual decentralization of the population by means of Land and Housing Reform and Town Planning Acts would do more to diminish measles than any other method previously suggested.

However, the discussion of these somewhat Utopian schemes for social reform are completely outside the scope of a medical paper, and until they are accomplished one must conclude that little success is likely to attend the most vigorous and energetic attempts to control measles on the part of Public Health Authorities. The utmost they can hope to do at present, is to provide better hospital accommodation, to educate the parents to give more care to the children attacked, and to check the spread in schools by scientific regulations.

The share of the school authorities and the limitations of their powers should be clearly recognised. Even by the greatest vigilance in detecting early cases and excluding unprotected children they cannot hope to diminish the incidence of measles in schools to any appreciable extent. It is almost universally acknowledged that "measles is only de facto, not de jure, a disease of childhood" (Bohn), and with increased age the children do not become less susceptible. Given a class of unprotected children in a town community and fresh infections with resultant

first crops are bound to be of frequent occurrence. But judicious exclusion can, if teachers and parents play their parts, prevent the occurrence of large second crops and of class to class spread. It is much better for the children that they should fall in a series of first crops than in one large second crop because valuable time is saved, and the attack may be delayed till an age when the case mortality is negligible.

If the Public Health and the School Medical authorities could together raise the average age at which school children took measles to seven, they might be well satisfied even if the total incidence of the disease was not much diminished. The risk of death or serious damage to health at that age is very slight, and the disturbance of school work is much less important than at a later age when the child is perhaps going up for a scholarship. This paper has endeavoured to show in which direction action should be taken.

SUMMARY.

(1) Measles shows slight tendency to diminish in incidence, and does not appear to be affected by the improvements in sanitation and Public Hygiene which are gradually decreasing the other exanthemata.

(2) The continued prevalence of measles to the increasing tendency of the population to concentrate in towns, thereby making it increasingly difficult to control a disease that spreads by personal contact.

(3) The continued high death rate of measles is due to the inability of the parents to provide proper treatment for complicated cases and to their carelessness in exposing convalescents and mild cases.

(4) The efforts of the Public Health Authorities should be directed towards educating the parents as to the gravity of the disease and the necessary precautions, providing good hospital accommodation for complicated cases and, indirectly, by improving housing conditions and diminishing overcrowding.

(5) Compulsory Notification of Measles is unjustifiable as the benefit is not commensurate with the cost. The only practical advantage it would bring, i.e. increased facilities for educating parents could be attained almost equally well through existing channels.

(6) Children in urban communities have so many opportunities of meeting that the spread of measles

is independent of school life, and a great proportion of the cases occur amongst those who have not reached school age. Therefore the exclusion of English children under five from school and the closure of schools during epidemics is not likely to be of much benefit in controlling the disease.

(7) While action in schools cannot prevent the occurrence of measles, yet it is incumbent on the School Medical Authorities to see that the schools spread the disease as little as possible. With this aim in view it is essential to secure prompt notification of cases on the part of the parents, a statement as to which of the children have had measles before, and vigilance in detecting early cases on the part of the teachers.

(8) The exclusion of the children in a class who have not had the disease from the ninth to the fifteenth day after the last attendance of the first case is the most economical and effective method of school regulation of measles.

(9) The extinction of measles, or even marked diminution in its total incidence is hardly to be expected under present conditions of town life. Much however could be done by raising the age at which children suffer and thus rendering the disease comparatively innocuous.

APPENDIX.

The routine adopted by the London County Council may be briefly described.

Each case of measles is treated on its merits. Immediately it becomes known to the teacher, she sends a notice to the Medical Officer (Education), of the date of the child's last attendance, the number of protected and unprotected children in the affected class, and their ages. These particulars are entered on a schedule, separate schedules being used for each school. The Medical Officer is thus enabled to see at a glance the amount of measles and the quantity of susceptible material in a school before he decides what action to take.

In all cases Circular M.O.119 q.v. is sent out immediately, with a view to confining the mischief to one class. In practice it has been found to work very well.

If the class contains only 20 per cent or less of unprotected children it is considered that the disease is not likely to spread, and no action is taken beyond sending a red card of warning (M.O.19a) in a sealed envelope to the parent of each unprotected child.

If the number of unprotected children is over 20 per cent those who have not had the disease are excluded from the ninth to the fifteenth day, and are

given a green card (M.O.19,q.v.). This ensures that the "first crop" falls out of school, and if the parents pay attention to the warning on the card and isolate their children promptly, a "second crop" should be avoided and the outbreak checked.

When a first case is missed, and the notification of several cases occurring within a few days in one room indicates that a "first crop" has fallen in school, closure or exclusion is rejected as futile. The great majority of the susceptible children have been already infected. No action is taken except distributing warning cards and instructing the teacher to exclude children with "bad colds."

If measles appears at the same time in several different classrooms, the unprotected children under 5 are excluded from the whole department, even if the individual classes are well protected.

Children from houses where measles is present are allowed to attend school in the Boys' and Girls' Departments, if they have had the disease themselves, but they are excluded from Infants' Schools. No case has ever been known to occur of infection being carried by these children.

During the interepidemic period of the past two years these measures were highly successful in preventing the spread of measles from class to class,and inspection of the schedules shows that the disease

was generally confined to the class in which it appeared, and that "second crops" were of fairly infrequent occurrence. During last autumn fresh infections were so rapidly introduced throughout the schools that in many cases it was impossible to check the march of the disease by the most prompt and vigorous action. The success of the Council's methods in the past two or three years had resulted in the accumulation of a great mass of susceptible children, who greatly magnified the difficulties of the problem.

M.O.119.

MEASLES.

Madam,

In view of the cases of Measles reported from your department, it is advisable that all mixing and massing of the children should, as far as possible, cease for the present. I shall be obliged, therefore, if you will endeavour to keep the various classes, especially those attended by the babies and younger children, separate from one another, both during assembly and dismissal (morning and afternoon), as well as in the use of the cloakrooms, and also in the playground, if possible.

In order to ensure the success of these precautions it is desirable that —

(1) Upon arrival the children should immediately proceed to their classes, without being assembled en masse;

(2) Upon dismissal at the end of each session, each class should leave the premises separately, and be sent home before an opportunity is afforded of playing or associating with other classes in the playground; and

(3) Recreation time should be so organised that each class may be kept distinct and separate during play.

The arrangements in connection with the whole procedure are necessarily left to your discretion, and perhaps you can suggest some means of overcoming any difficulties that may be encountered.

As infection is more commonly communicated during the "scramble of play" than in the classroom, I feel sure that stringent measures on the lines I have indicated, if adopted, will be the means of localising, and consequently of checking, the spread of the disease.

Yours faithfully,

JAMES KERR,

Medical Officer (Education).

The Head Mistress.

M.O.19a.

Obverse.

(Red card)

"As a case of measles has occurred among the scholars in the class which your child attends, it is possible that ———————— may have contracted the disease. As it requires about twelve days for measles to develope, you are requested to pay particular regard to the state of your child's health during the NEXT THREE WEEKS, and upon the slightest sign of illness to abstain from sending her to school.

M.O.19.

Obverse.

(Green card).

As measles has occurred among the scholars it has been decided to exclude your child till ———— Measles is very infectious. You are therefore cautioned, in the event of your child showing any signs of this disease, to keep ——— from contact with other children or from exposure in public places until a fortnight has elapsed after exposure to infection. A child who appears only to have a slight cold may have contracted measles and be dangerous to others. Any child who has contracted measles must not resume school attendance for a month.

Reverse.

(Both cards).

Note.

Measles may be a very serious illness in young children and many die from it. The early symptoms are those of a cold which may be at first slight; there is generally running at the eyes and nose, sneezing and possibly cough. Many children lose their lives because parents allow them to go out of the house, thinking that the indisposition is only a slight cold, when it is really measles.

TABLE A.

London Epidemic 1910 to 1911.

Week Ending	Cases in Elementary Schools	Schools affected	Deaths. in whole population
1910.			
Nov: 26	800	181	94
Dec: 3	884	188	113
Dec: 10	1,083	173	66
Dec: 17	School Holidays		83
Dec: 24	Total cases	Total schools	90
Dec: 31	3,825	298	84
1911.			
Jan: 7	or		72
Jan: 14	765 per week		86
Jan: 21	790	152	82
Jan: 28	812	215	82
Feb: 4	1,286	244	95
Feb: 11	1,597	294	86
Feb: 18	2,022	317	103
Feb: 25	2,847	383	132
March 4	3,001	448	136
March 11	2,899	420	175
March 18	2,197	367	197
March 25	1,487	341	182
April 1	905	299	153

TABLE B.

Cases occurring in Glasgow Schools before and after the Christmas Holidays, (21st December to 11th January).

Period (3 weeks) ending	No. of Cases 0–5 years	5–15 years	15 + years	Increase or decrease 0–5 years	5–15 years	15 + years	Totals.
21st Dec:, 1907	1,732	1,054	35				2,821
11th Jan:, 1908	2,197	1,040	51	+ 465	− 14	+ 16	3,288
31st Jan., 1908	1,611	587	42	− 586	− 453	− 9	2,240

TABLES C and D.

Proportion of Deaths from measles to every 10,000 specified causes of death in the 8 principal Scottish towns.

Year	The 8 towns	Glasgow	Edinburgh	Dundee	Aberdeen	Paisley	Leith	Greenock	Perth
1908	357	549	150	45	267	316	115	331	34
1909	187	264	101	13	126	472	26	9	67

Death Rate per 100,000 persons living in Scotland.

Year	Glasgow	Edinburgh	Dundee	Aberdeen	Paisley	Leith	Greenock	Perth.
1908	97	23	8	36	50	18	57	14